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ABSTRACT

Open area designs for school buildings were adopted frequently in Australia in the 1970s, often without adequate preparation of the educators who would be using them. A study of the effects of open area designs led to the recognition that school building design warrants more serious attention as a variable in formal education than it has yet received. The study involved testing 18 students at the fifth year level in each of 120 different schools. These schools were of four types: one conventionally designed and three of the open plan type (mixed, double-space, and multispace designs). The study results indicated that conventional schools promoted better cognitive outcomes, while open plan schools supported better affective outcomes (at least in schools of high and middle social status). These results are not conclusive, however, in that the open plan schools may not have been operating under ideal circumstances (including optimum occupancy and full use of their flexibility and resultant instructional options) for an adequate test of their potential. The document concludes with the author's comments on some conceptual problems associated with research into educational environments, such as the meaning of the terms "environment" and "openness" themselves. (Author/PGD)

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AN AUSTRALIAN STUDY OF SCHOOL ENVIRONMENTS

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AN AUSTRALIAN STUDY OF SCHOOL ENVIRONMENTS*

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The purpose of this paper is to describe briefly a large national study of the influence of openness of school buildings upon teaching practices and pupil outcomes, to consider the implications for educational practice, and to explore some conceptual issues relating to research into school environments.

Context of the Study

In the early 1970's Australian school systems began to show evidence of British and North American influence in the adoption of open area designs for school buildings. The few published statements which attempt to explain the educational reasons for this development in Australia have generally avoided the endorsement of particular styles of teaching but have rather emphasised the flexibility of such buildings which would allow teachers to cater more adequately for the diverse needs of pupils.

However, the advent of open area school buildings was accompanied by a wave of literature on open education, and many teachers assumed that open education was that which was supposed to occur in open area schools. This situation seemed to call for clarification.

The Australian Open Area Schools Project was commissioned by the Australian Advisory Committee for Research and Development in Education (now the Education Research and Development Committee) as a national study involving the six State and two Territory Education Departments. The purpose of the study was to assist in the evaluation of open area school buildings, with particular reference to the influence of building design upon teaching practices and pupils' achievements and attitudes.

The variables

The aim of the study was to investigate the relationships represented in Figure 1, in which school design provided the independent variable, pupil outcomes and teaching practices the dependent variables, and teaching practices also a possible mediating variable.

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*This study is reported more fully in Angus, M.J., Beck, T.M., Hill, P.W. and McAtee, W.A. Open Area Schools - An evaluative Study of Teaching and Learning in Primary Schools of Conventional and Open Area Design in Australia. E.R.D.C. In press. This author's indebtedness to colleagues is acknowledged.

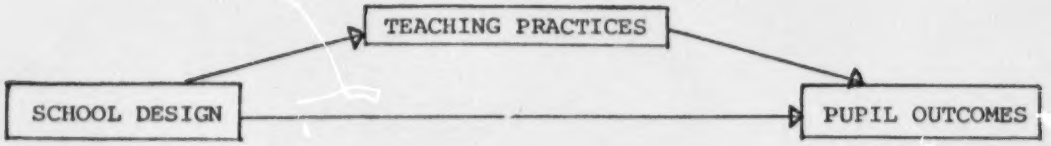

FIGURE 1: RELATIONSHIPS INVESTIGATED BETWEEN KEY VARIABLES

The property to be measured in relation to school design was openness, and for this purpose the following categories were employed:

1. Conventional design - with self-contained, one-teacher classrooms.
2. Mixed design - with both self-contained and open area units.
3. Double-space design - with two-teacher open area general learning areas.
4. Multi-space design - with open area general learning areas equivalent in size to three or more conventional classrooms.

Openness of teaching practices was measured by means of a teacher questionnaire developed to operationalise a definition of 'openness' which had been derived from the open education literature. There were similarities between this instrument and others such as those developed by Traub, Weiss, Fisher and Musella (1972) and by Walberg and Thomas (1972) but it was considered necessary to devise a local version to accommodate the range of practices to be found amongst Grade 5 teachers in Australian State schools.

Pupil cognitive outcomes included mathematics (ACER Mathematics test AM5 Money), reading comprehension (Part 2 Form 2 ACER Primary Reading Survey Test) and written expression, and the affective outcomes included in the final analysis were self esteem (modified Coopersmith Self Esteem Inventory) and attitude to school (Watkins and Sampson, 1974). An adaption of Bialer's (1961) scale to measure independence or locus of control was piloted successfully but a traditional item analysis of the scores from the full sample of pupils yielded extremely low item discrimination indices. However, for the Rasch model all items appeared to refer to a unidimensional trait and formed a very conformable set. Inability to resolve this discrepancy beyond question resulted in a decision not to pursue the analysis of responses to this instrument. This problem is reported by Thomson and Parkin (1975, 1976).

A number of extraneous teacher and pupil variables were recorded in an endeavour to account for any between-group differences which may have been found.

Method

A two-stage sampling design was used and data were collected from a target sample of 120 schools of different design types and from a random sample of 18 pupils in Year 5 within each of the schools. The data, collected during the 1974 school year, included two measures of the cognitive and affective outcomes for each pupil, in April and November, using the same instruments on both occasions.

The basic analysis model was a one-way analysis-of-variance design with four levels of the independent variable (see Figure 2).

SCHOOL DESIGN

CONVENTIONAL	Open Area: MIXED	Open Area: DOUBLE-SPACE	Open Area: MULTI-SPACE
N=45	N=24	N=25	N=21

FIGURE 2: THE BASIC ANOVA DESIGN

Tests of significance of the differences between group means were used to ascertain the degree of association between school design and dependent variables. In analysing the pupil outcomes the two measures (April and November) were regarded as intercorrelated responses from the same subjects and, after aggregation at the school level, were analysed conjointly according to a bivariate MANOVA model. In addition, covariance adjustments were incorporated into the analysis so that pre-existing differences between schools in terms of pupil age, general intellectual ability and social status could be taken into account.

The more important results of the study are summarised in Tables 1 to 3. So that direct comparisons may be made between the various outcome measures, standardized estimates of effects* have been tabled for the three types of open area designs, along with both the bivariate and univariate F tests for the first Helmert comparison between the conventional design schools and the three open area design types.

Teaching Practices

The teacher questionnaire was completed by 367 teachers who taught the Year 5 pupils in the selected schools. However, the responses from teachers were aggregated to provide school means, which were the data used in the analyses.

Though openness of teaching practices and openness of buildings are distinct concepts, it was anticipated that open teaching practices were more likely to be found in open area schools than in conventional design schools. A subset of items within the teacher questionnaire related to joint effort (cooperation) amongst teachers, and the responses to these items have been analysed separately as well as included in the total scores. Co-operative teaching has been widely accepted as a desirable outcome of open area school building design.

TABLE 1: TEACHING PRACTICES

Outcome	Standardized Estimates of Effects				Tests of Significance (a) (d.f.)
	Open Area School Designs			Total	
	Mixed	Double	Multi		
Openness	1.23 (b)	1.19	1.33	1.25	30.00* (1,111)
Joint Effort	1.17	1.80	1.73	1.57	38.28* (1,111)

* $p < .05$

(a) For the first Helmert contrast: conventional versus all open area categories.

(b) Conventional design having been standardized at 0.00, this category scored 1.23 standard deviations above 0.00.

* For Table 1 defined as the difference between the means of the conventional design schools and the respective groups of open area schools, divided by the standard deviation of the conventional schools; for Tables 2 and 3, defined as the difference between the adjusted means of the conventional design schools and the respective groups of open area schools, divided by the adjusted pooled within-groups standard deviation.

Cognitive Outcomes

As reading, mathematics and written expression are explicit goals of all schools in the education systems involved in this study, there were no a priori grounds for expecting to find differences on measures of these variables between schools of the various architectural designs. Table 2, however, shows a consistent trend towards higher scores for the conventional design schools. While the differences between group means were statistically non-significant in the case of the two measures of written expression, tests employing the basic analysis model confirmed that there were significant differences in mathematics and reading between the group means for the conventional design and open area schools, though not between the mixed design and the other open area schools nor between the double and the multi-space schools.

This does not mean, of course, that all the conventional schools did better than all the open area schools in mathematics and reading. There was considerable overlap between the four categories. Nevertheless, on average the conventional design schools outscored the open area schools.

The contrast between conventional and open area schools accounted for 9.8% of the variance in the mathematics scores (adjusted for age, general ability and social status) and 6.9% in the adjusted reading scores. In terms of standard deviations, the adjusted mean mathematics scores for the conventional design schools were approximately .6 of a standard deviation higher than those for the open area schools, while the corresponding scores for reading differed by .5 of a standard deviation.

No other variables were found to account for these results. In particular, openness of teaching practices was found to unrelated to any of the pupil cognitive outcomes.

Affective Outcomes

As can be seen from the estimates of effects in Table 3 there was a slight trend in favour of open area schools with regard to attitude to school.

In the case of self esteem, there was an interaction effect between school design and social status. In the high and middle social status schools, levels of self esteem were higher in the open area schools. However, in the low social status schools, the pattern was reversed and the levels of self esteem were higher in the conventional schools. In other words, with regard to self esteem, conventional design schools appeared to benefit pupils of low social status and open area schools were more suited to pupils of high and middle social status.

Neither attitude to school nor self esteem related to openness of teaching practices.

TABLE 2: Pupil Cognitive Outcomes

Outcome	Time of Testing	Standardized Estimates of Effects					Tests of Significance (a)	
		Open Area School Designs			Total		Bivariate F (d.f.)	Univariate F (d.f.)
		MIXED	DOUBLE	MULTI				April Nov
Mathematics	April Nov	-0.57 -0.77	-0.53 -0.57	-0.77 -0.62	-0.62 -0.65	-0.64 (b)	5.80* (2,107)	9.65* 10.75* (1,108)
Reading	April Nov	-0.52 -0.70	-0.35 -0.49	-0.58 -0.41	-0.48 -0.53	-0.51	3.95* (2,107)	5.72* 7.36* (1,108)
Written Expression I	April Nov	-0.81 -0.59	-0.17 -0.07	-0.44 -0.62	-0.47 -0.43	-0.45	2.98 (2,106)	5.60* 4.38* (1,107)
Written Expression II	April Nov	-0.49 -0.59	-0.03 -0.06	-0.37 -0.33	-0.30 -0.32	-0.31	1.40 (2,107)	2.08 2.59 (1,108)
Total	April Nov	-0.60 -0.66	-0.27 -0.30	-0.54 -0.50	-0.47 -0.48	-0.48		

* $p < .05$

(a) For the first Helmert contrast: conventional versus all open area categories.

(b) Conventional design having been standardized at 0.00, in mathematics overall the open area schools scored 0.64 standard deviations below 0.00.

TABLE 3: Pupil Non-Cognitive Outcomes

Outcome		Time of Testing	Standardized Estimates of Effects					Tests of Significance (a)		
			Open Area School Designs			Total		Bivariate F (d.f.)	Univariate F (d.f.)	
			MIXED	DOUBLE	MULTI				April	Nov
Attitude to School		April	0.45	0.27	0.54	0.42	0.37 (b)	2.15 (2,107)	4.25* (1,108)	2.75 (1,108)
		Nov	0.47	0.19	0.32	0.33				
Self Esteem	High Social Status	April	0.43	0.68	1.36	0.82	0.81	(School design x Social Status interaction) 1.92* (12,198)	2.43* (6,100)	1.98 (6,100)
		Nov	0.81	0.19	1.38	0.79				
	Middle Social Status	April	0.46	0.55	0.19	0.40	0.35			
		Nov	0.13	-0.13	0.90	0.30				
	Low Social Status	April	-1.58	-0.58	-1.21	-1.12	-0.84			
		Nov	-0.61	-0.25	-0.79	-0.55				
Total		April	-0.06	-0.23	-0.22	0.13	0.17			
		Nov	-0.20	0.00	0.45	0.22				

* $p < .05$

(a) For the first Helmert contrast: conventional versus all open area categories.

(b) Conventional design having been standardized at 0.00, in attitude to school the open area schools scored 0.37 standard deviations above 0.00.

Implications for the School Systems

For the school systems involved in the study the main finding was that with regard to numeracy and literacy amongst Year 5 pupils in 1974, achievement levels in open area schools were lower than those in conventional design schools. The other findings, such as the lack of association between openness of teaching practices and pupil outcomes, or the interaction between school design and social status with regard to pupils' self esteem, raise additional issues which will not be discussed in detail in the present paper.

The research has not proved that conventional classrooms are the best of all possible school designs, nor even that they are better than open area. What then could explain the results, assuming that the research design itself was valid for this investigation? Several possibilities present themselves:

1. The new designs were introduced to school systems without prior enquiry as to whether Australian teachers (with their particular traditions of teaching and school organization) could cope with them, and without a concerted program to encourage teachers to develop and disseminate appropriate teaching strategies during the early years.

2. There is evidence that the open area characteristics of a building are seriously negated where the number of people occupying the building or particular spaces exceeds the optimum. Some schools were designed with 'home' areas considerably smaller than a typical classroom on the assumption that some pupils would always be occupying specialist areas of the buildings. Where teachers have tried to conduct classes in the conventional manner, with the basic teacher/class unit of organization, there is crowding of the general learning areas and continuous distraction of and from adjacent classes.

3. There is reason to doubt that the flexibility of open area schools has been realised, partly for reasons of crowdedness as mentioned above, and partly because having to cooperate with other teachers in almost everything one does may make it less easy to innovate in an open area school. In any case, gross changes to the internal

configuration of a school building may take considerable effort, and as the buildings belong to the Public Works Department there is apt to be lacking a sense of ownership and a commitment on the part of teachers and pupils to making the buildings serve their educational purposes.

4. A final reason why open area schools were less successful in the basic subjects may have been a sense of uncertainty regarding official and professional expectations of what should happen in such schools. There was a strong assumption that something different was required. 'Open education', at that time, was the most obvious candidate to fill the vacuum. However, the lack of guidance on this issue plus confusion within the open education literature itself may have left many teachers unsure of their priorities, their values and their teaching strategies. Teachers who were appointed to open area schools had many new environmental factors to deal with, and in 1974 many of their problems had not been resolved.

Perhaps the main general conclusion to emerge from the study is that school building design warrants more serious attention as a variable in formal education than it has hitherto received. It should not be taken for granted that teachers will readily adapt to an environment that is radically different from what they have experienced before. Further, because there has not been a carefully controlled program of development and evaluation of teaching practices suited to open area schools, it cannot be claimed that the new designs have been given a fair trial. There remains an urgent need to carry out research which looks at methods and facilities simultaneously. Building designs do not have merit in their own right, but only in relation to the functions performed within them. If we do not know what functions we want to perform it is difficult to evaluate the suitability of a building design. However, even if a new design is created in the genuine expectation that it will be an improved facility for a specified type of program, it is still necessary to evaluate the design from three points of view:

- whether the intended teaching and learning program is in fact facilitated;
- what additional, unexpected advantages can be exploited as a result of the creative use of the facility;
- what disadvantages emerge, which may be remedied in subsequent designs.

Teaching and learning occur in a physical environment. The optimum marriage between program and physical environment will only be achieved if development and evaluation occur continuously and simultaneously in both directions:

- What kind of facility is needed for this program?
- What kinds of program can be implemented in this facility?

The Study of School Environments

The purpose of this section is to comment upon some conceptual problems which need to be recognised in connection with research into educational environments.

First, what is the meaning of 'environment'? In the 'heredity versus environment debate, environment is almost everything. Shulman implies this meaning when he states:

> Until the gene is as manipulable as the printed word, the educator's only tool will be the modifiable environment. It is the environment which he must manipulate in his studies and from which he fashions the settings of formal instruction' (Shulman, 1970. p. 382)

Being slightly more specific one could refer to Walberg's (1976) chapter entitled 'Psychology of Learning Environments" in which he mentioned human environments, social environments, family environments, peer environments, community environments, classroom environments, school environments and educational environments. To this list could be added physical environments, natural environments, work environments, and so on, being expressions which represent particular segments or facets of our surroundings.

But these environments do not in themselves constitute research variables - it scarcely makes sense to speak of having more environment or less environment. Rather, there is a need to consider particular properties in terms of which the environments can be described and measured. However,

when the particular environment to be investigated and the properties to be measured have been designated, it is highly likely that a term other than 'environment' will be more appropriate. The key to whether a thing (eg. environment) is likely to be useful in research is whether there are properties which meaningfully apply to it.

Whether or not the term 'environment' is retained in education discourse it is legitimate to consider the validity and usefulness of research which investigates properties of broad categories of phenomena such as social climate, teaching practices or physical (dare I say?) environments. Goodlad pointed to the problem which drives us to grapple with phenomena at a high level of generality:

> .... we have an extensive array of tested, refined techniques for observing and measuring classroom phenomena ... they constitute dozens, perhaps hundreds, of discretely conceptualized and separately calibrated pieces. The cumulative picture derived from putting together all the data collected from various ways of studying components of schooling would not reveal to us a school..... an entity with component parts always in some kind of dynamic interaction.....(Goodlad, 1977, 3-5)

Yet when somebody investigates a property of a very general domain, others point out that such research fails to deal with the particulars which directly affect the learning of individual children. For example, Grannis (1978, p.29) comments regarding Bennett's (1976) research that it "connects achievement with various summary characteristics of formal, mixed and informal classrooms but does not discriminate between settings within classrooms."

It is perhaps useful to conceive of a hierarchy of environments. An event, such as a learning experience, takes place in the context of circumstances peculiar to the child, the class, the school and the system. It is a matter for judgement whether research into pupil achievement using the school as the level of analysis is relevant to the learning experiences of particular children.

However, another kind of hierarchy also needs to be recognised, that is the relationship between the general phenomenon being investigated (eg. teaching practices) and the particulars which constitute the domain of that phenomenon. In the present study the independent variable was openness of

school buildings, in which only a single judgement was required to determine the value of openness to be attributed to each school (though this theoretical simplicity belies the difficulties and alternatives which in fact were encountered in defining and operationalising this variable). In contrast, openness of teaching practices had to be a composite measure involving judgements about the openness of numerous discrete teaching practices or facets of teaching practice. But each practice had to be judged on the basis of a definition of openness of teaching practices, not on the basis of a definition of openness that might apply to each practice independently. Barth, for example, considered 'open education' to be a suitable term for what he saw in some British infant schools because:

> .... doors are ajar, and children come and go; classrooms are open, and children bring objects of interest in and..out; ... Time is open, to permit and release rather than constrain or prescribe. the curriculum is open to choices....Teachers are open to the possibilities inherent in children...(and so on).
> Barth, 1972, 55 - 56)

In this passage Barth has taken several parts or aspects of the school environment, applied a particular meaning of 'open' to each of them, then used the term 'open' to describe the whole. As a quasi-definition he concluded:

> In short, open education implies an environment in which the possibilities for exploration and learning of self and the world are unobstructed.

Was this a poetic derivation from several different meanings of 'open' as applied to doors, classrooms, time, curriculum and teachers? To leave a door open (to the bathroom, for instance) does not necessarily mean that 'the possibilities for exploration and learning of self and the world are unobstructed'. The applicability of a definition of a property of a specified environment must be tested for each instance and facet of the domain, keeping one's focus firmly on the one definition. It will be found extremely difficult to decide, in many cases, whether a particular practice or circumstance is relevant to a measure of openness. Would it be the case, for example, that an observation schedule or questionnaire to measure openness of the school environment or openness of teaching practices would literally ask whether the classroom door was kept open?

To conclude this sketchy treatment of a complex issue, it is worth noting that the definition of 'openness' seems inescapably to entail value judgements. 'Unobstructed opportunites for learning' must surely be the ideal of every education program. Similarly, in the Australian Open Area Schools Project, it was concluded that the open education literature as a whole supported a definition in terms of "The extent to which the teaching practices are characterised by respect for every child as a person". There is not time to explore all the implications of that definition, but the issue here is what kind of research or evaluation could be useful with a variable in which particular manifestations are by definition better than others.

Perhaps this is a reminder that many aspects of our school programs are determined and must be determined by our beliefs as citizens rather than by the supposedly objective findings of research. There are characteristics of classroom environments and teaching practices that are believed to be good for their own sake. Such characteristics are thus more appropriately researched as dependent rather than independent variables. Where they are investigated as independent variables and related to other outcomes this may help to identify specific weaknesses in a program but it will not, if we are clear as to which are purely empirical issues and which are moral or belief issues, cause us to reject characteristics of the school program that are valued for their own sake.

Conclusion

The research reported in this paper seems to point to the following conclusions:

The reciprocal and complementary relationships between the design and the use of school buildings need to attain greater prominence in the thinking of, and communication between, teachers, administrators, researchers, architects, and those who train teachers.

The school environment is a composite of buildings, curriculum and persons, and the neglect of any one of these components is likely to weaken the effectiveness of the whole.

The knowledge which informs decision-making in these matters must derive both from empirical research and from the beliefs and values which determine the goals of the school program.

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